Investigation Of Northern Goshawk Nest Site Locations In Relation To Riparian Areas In The Centennial Mountains, Targhee National Forest

FINAL REPORT FOR RESEARCH AGREEMENT
#INT-92938-RJVA
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INVESTIGATION OF NORTHERN GOSHAWK NEST SITE LOCATIONS IN RELATION TO RIPARIAN AREAS IN THE CENTENNIAL MOUNTAINS, TARGHEE NATIONAL FOREST

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Final Draft
30 September 1994

Submitted to: Forestery Sciences Laboratory
Intermountain Research Station
USDA Forest Service
Boise, Idaho

AGREEMENT NO. INT-92738-RJVA

INTRODUCTION

The breeding range of the Northern Goshawk (Accipiter gentilis) in western North America extends from treeline in Alaska and northern Canada southward throughout the montane forests of the United States and into northern Mexico (Palmer, 1988). Over the past decade, concern has developed that timber harvesting and resulting habitat loss in some areas may be causing declines in goshawk breeding populations (Reynolds et al., 1983; Herron et al., 1985; Bloom et al., 1986; Reynolds, 1989; Crocker-Bedford, 1990; Patla, 1991; Reynolds et al., 1992;).

Due to these concerns the USDA Forest Service Intermountain Region (FSIMR), which administers public lands in southern Idaho, western Wyoming, Nevada, and Utah, listed the goshawk as a "sensitive species" in 1991. Since an estimated 70% of potential nesting habitat for goshawks in Idaho is located on Forest Service lands where timber harvesting and other management activities occur, data on habitat use and population status are needed to develop adequate management guidelines (USDI, 1991).

Studies on goshawk nesting habitat in the United States have focused primarily on describing and measuring the vegetative structure of nest sites. Although a number of studies on goshawk

nesting habitat have reported that nests are often located near permanent water sources (Shuster, 1980; Reynolds et al., 1982; Speiser and Bosakowski, 1987), the relationship between nesting habitat and water sources has not been adequately determined. Most studies have not described the type of water source or riparian habitat closest to nesting areas, and consequently, management recommendations are vague in regards to these features.

The most detailed goshawk management guidelines developed to date for the USDA Forest Service Southwestern Region state simply that goshawks often place nests near streams in older-aged, high canopy cover forests (Reynolds et al., 1992). Recommendations call for designating three suitable and three replacement nest areas with "most" to be located on northerly aspects in mesic areas along drainages. The guidelines give no recommended distances between water sources and designated nest stands. They also do not describe what types of drainages or riparian habitats may be most suitable for nesting habitat.

The FSIMR is currently reviewing and modifying Southwestern goshawk management guidelines to include more northern habitat types found in the Rocky Mountains and adjacent areas (Ron Rodriguez, Dixie National Forest, pers. comm). Very little specific data exist, however, on location of goshawk nests in relation to riparian habitats in the central and northern Rocky Mountain area. In northern Colorado, 20 goshawk nest sites were

found 10-450 m from water with most within 275 m. (Shuster, 1980). Seventeen nests in northern Idaho and western Montana were located generally within 0.5 km of water (Hayward and Escano, 1991). In the Centennial Mountains of northeastern Idaho, 1989-1992, we found 14 active nests located an average distance of 238 m from water (range 30-534 m; 180 m SD) (Patla, unpublished data). None of these studies located nests using randomized systematic surveys of defined study areas, however, so it cannot be concluded that goshawks were actually selecting for riparian attributes in nesting areas.

To determine if goshawks disproportionately select nest sites near riparian areas, we used broadcast vocalizations to survey a relatively undisturbed 85 km^2 portion of the Centennial Mountains in northeastern Idaho for active goshawk nest sites. In addition to determining the importance of riparian areas in goshawk nest site selection, our objectives were: 1) to describe more specifically water sources and riparian habitats located in goshawk nesting areas, 2) to obtain a better understanding of goshawk nest site density, and 3) to evaluate potential bias of our existing goshawk nest site database for the Targhee National Forest which consists of nest sites found opportunistically over the past decade.

STUDY AREA

The study area encompasses rugged, forest-covered montane

terrain on the south and east facing slopes of the Centennial Mountains on the Targhee National Forest northwest of Kilgore, Idaho (Fig. 1, 2). This area was chosen because of its relatively undisturbed condition. It extends south from the Continental Divide (Idaho-Montana State border) to West Camas Road (#006), and in the east-west direction from East Camus Road (#026) and Spruce Creek to Pete Creek Road (#010). Elevation ranges from 1982 m to over 2744 m. Approximately 96 km of stream drainages are located within the study area; 44 km are classified as perennial. The interior of the study area is unroaded and contains less than 6.2 km of maintained trails.

The climate consists of relatively dry summers and cold, harsh winters with snow persisting at higher elevations from November through late April/late May. Annual precipitation between 1982-1992 averaged 74.4 cm at the Crab Creek weather station (2091 m elevation) located south of the study area (Station #3428, National Climatic Data Center). Monthly average precipitation ranged from a low in August of 3.74 cm to a March high of 9.30 cm. Snow depth in January, March and April averaged 51, 109, and 137 cm. respectively. Average monthly temperatures at Kilgore (1927 m elevation) between 1962-1977 (only available data), ranged from 13 degrees C. in January to 58.9 degrees C in July (Station #4908, National Climatic Data Center).

The major habitat type found within the area is Pseudotsuga

menzensii/Calamagrostis rubescens (PSME/CARU; Douglas fir/pinegrass) which occurs up to 2469 m (Steele, et al. 1983). At higher elevations, stands of White-bark Pine (Pinus albicaulis) and subalpine fir (Abies lasiocarpa) prevail. Other tree species found within the area include aspen (Populus tremuloides), lodgepole pine (Pinus contorta) and Engelmann spruce (Picea engelmannii). The most extensive forest habitat occurs below 2500 m. (8200 ft.); above this elevation forest stands are more fragmented by natural meadow openings or steep rock cliffs and talus slopes.

At lower elevations outside the study area, agricultural fields and sagebrush (Artemesia tridentata) meadows are bisected by the major drainages of East and West Camus Creeks and Pete Creek. Willow (Salix, sp.) and aspen prevail along the stream courses. North of the study area in Montana, the forested north-facing slope of the Centennial Mountains drops down to the Centennial Valley. The status of the goshawk population on the north side of the Centennial Mountains remains largely unknown except for a few sight records of individual birds (Marco Restani, Utah State University; Dr. Jack Kirkley, Western Montana College, pers. comm.).

The study area encompasses one of the largest contiguous, unroaded, lower elevation sections remaining along the southside of the Centennial Mountains. Some timber harvesting and road

building occurred in four areas along the periphery of the area prior to 1993: Spruce Creek timber sale on the northeastern side (1985: 210 ha); Saw Creek sale on the southeastern (1983: 101 ha); Bear Gulch sale on the south (1984-86: 445 ha), and Pete Creek sale on the west (1985-87: 420 ha) In the Saw Creek area, harvesting removed some of the large diameter Douglas firs but left a well developed canopy intact. In the other timber sale areas, a larger percentage of the overstory canopy was removed from harvest units leaving much more open stands (Kim Johnson, Wildlife Biologist, Dubois Ranger District, pers. comm.) The most extensive road building associated with timber sales occurred in the Pete Creek and Bear Gulch areas but locked gates prevent motorized use on many of these roads. None of the open roads extend into the interior of the study area.

Seven existing grazing allotments are at least partially contained within the survey area. In most years, grazing occurs between mid-June to mid-October. On the East Camus allotment, cattle grazing (150 cow/calf pairs) is restricted to a small area mostly on open sage meadows along the edge of the forest. More extensive grazing occurs within forest habitat along the slopes which drain into West Camus Creek east of Bear Gulch and west of Pete Creek (908 cow/calf pairs). In 1992, only one sheep allotment was in use (1000 ewe/lamb pairs) on the higher elevation slopes of East Camus Creek near Big Table Mountain near the Montana border. Three other sheep allotments were inactive.

METHODS

SURVEY METHODS

We conducted surveys for goshawks within the study area using a modification of Kennedy and Stahlecker's (1993) {Kennedy and Stahlecker, 1993} broadcast survey method during the nesting and fledgling periods from June 17 through August 10, 1993. From mid-June to mid-July, we played the goshawk "alarm" call to elicit responses from nesting goshawks. From mid-July through early August we used the adult female "wail" call. This vocalization, given by the adult female during the nesting period when the male brings prey to the stand, often elicits food-beg calls from juvenile goshawks. In mid to late August, we also played a few alarm calls after the wail call sequence as we have found that young often respond to this call as well. Taped calls were obtained from Sullivan Recording (Ashland, OR) which produced tapes originally recorded on the Klamath National Forest in northern California (Brian Woodbridge, Wildlife Biologist, Klamath National Forest, pers. comm.)

Upon arriving at a station, observers played the tape for 10 seconds while moving the megaphone in an arc from 270 degrees to 90 degrees while facing forward on the transect line. We then listened for one minute while visually scanning for goshawks flying in silently. We then played the tape for 10

seconds in each of the four cardinal directions, with a 30 second pause between each sequence. After scanning the area for another minute, we continued on to the next station. While moving between stations, observers listened continually for vocalizations and looked for nests, prey remains and feathers. We also recorded other bird and mammal species sighted along transects.

Based on dominant aspect and drainage patterns, the study area was divided into seven subsections on 7.5 min USGS quadrangle maps. Within each section, parallel transect lines were drawn 260 m apart, with orientation dependent upon topography and accessibility. Observers played goshawk vocalizations at stations every 300 m along these predetermined transect lines even if stations occurred in open meadow or harvest areas. Broadcast stations were staggered by 150 m on adjacent transect lines in order to achieve an estimated coverage of 90.6% of the survey area (Joy et al. 1993). We used a modified Radio Shack Power Horn (model 32-2030) attached to a Sony (Walkman model WMA53) portable cassette tape player which produced a call 100-100 db which was audible to the human ear at a minimum of 150-300 m (pers. obs). We postponed or terminated surveys on days when either rain or wind over 20 km/h occurred.

For efficient utilization of available field time, observers followed a slightly different protocol to survey fragmented

forest stands in previously harvested areas located on the northwest and northeast edges of the survey area (Pete Creek Timber Sale and Spruce Creek Timber Sale), and in naturally fragmented habitat in the northern third of the area. Exploratory trips were first made into these areas to determine the condition of remaining mature timber stands (density and canopy cover) and to assess which stands contained trees of adequate size and structure to support goshawk nests. To be classified as suitable, stands had to have over 30% canopy cover and contain trees at least 15 m in height. When observers returned to survey areas, they determined the placement of transect lines after visually inspecting suitable stands making sure that broadcasts reached all identified nesting habitat. Calling stations were set every 150-250 m along these transects. No calling stations in these fragmented habitats were located in open meadow areas or on talus slopes.

In mid to late August, observers returned to locations previously surveyed within the study area where goshawks or unidentified raptor vocalizations had been reported either in 1993 or previous years but where nests had not been found. We conducted intensive calling surveys and visual searches for nests in mature timber stands within 2 km of reported observations. In addition, a few days were dedicated during the third week of August to search for fledged young in forested habitat located east of the designated survey area. We surveyed prime habitat

(mature Douglas fir stands on north facing slopes selected prior to the surveys from aerial photos) along Trail Creek, Lake Creek, Coal Mine, and Aldous-Hancock Lake trails.

Four sampling subsections located at elevations below 2439 m were surveyed prior to the three higher elevation sections due to the persistence of snow and wet trails until late June in 1993. We randomly selected the section and transects to be surveyed each day. Exceptions to this occurred for some transects located in the interior of the study area. For these, base camps were set up and surveys were clustered for 2-3 day periods in one area. Observers never surveyed adjacent transects during the same time to avoid mistaking taped calls for hawk responses.

Hawk responses to taped calls were classified by type and species. Possible goshawk responses included vocalization, approach and vocalization, silent approach, and fly-by with or without vocalization. Observers recorded the station, time, species, type of response, distance to hawk, age and sex of hawk if determined, and bearing of hawk if sighted in flight. We also noted responses from other bird species. After a goshawk response, 30-60 minutes were allocated to search for an active nest before continuing the survey. If no nest was located after a response, a team of two-three people would return and search within 2 km of the response location. Once an active nest was

located, no additional surveys were conducted within 1.2 km of that nest. This prevented disturbance to nesting hawks and also increased survey efficiency since goshawk nests in the western United States occur at spacing greater than 1.2 km (Reynolds, 1983; Woodbridge, et al.,1994).

Two volunteer field interns completed all transect surveys. They received instructions on identification and vocalizations of local raptor species. Visits to active nest sites and observation periods in a blind placed 35 m from a goshawk nest familiarized them with specific goshawk behaviors and calls. They were also trained to recognize imitative calls by other species such as the Gray Jay (Perisoreus canadensis) and Steller's Jay (Cyanocitta stelleri). Before commencing transect surveys, they also attended a two-day workshop (Idaho State University Outdoor Program) in map interpretation and orienteering.

SURVEY ANALYSIS

We mapped locations of all active and alternate goshawk nests on aerial photos (1:15,800) and 7.5 min USGS orthoquad maps. Precise UTM coordinates were obtained using a Trimble Basic Geographic Positioning System (GPS) unit. Satellite fixes were collected in the 3-D mode. We then differentially corrected positions using a local base station. Distances to nearest water

source from all nests were measured on quadrangle maps and also with the PFPRO GPS software mapping function. We also measured inter-nest distances using GPS.

RIPARIAN AREA/GIS LANDSCAPE ANALYSIS

Riparian areas found closest to active goshawk nests were classified according to a riparian habitat gradient developed in the Centennial Mountains for a study of non-raptorial bird distribution (Douglas, et al., 1992). We also identified riparian vegetation at each site to species level where possible.

The Targhee National Forest provided forest-wide ARC/INFO GIS coverages for vegetation, drainages, water sources, and roads for habitat analysis of the overall study area. The vegetation layer was developed from existing forest stand inventory data. Landsat images were used by the Forest to classify those areas not covered in the forest stand inventory database. A stand (polygon) was classified as being covered by a single tree species if inventory plots contained 85% or more of that species. Otherwise it was identified as a mixed species stand. Forested stands were also classified to size class and harvest history.

We created a separate GIS coverage of the study area to determine area surveyed, and also to measure the proportion of cover types existing within the area. We also classified the

study area into either **near-riparian** (all area located within 250 m buffers set around permanent water sources) or **non-riparian** (all remaining area outside of the 250 m buffer zones). We calculated the proportion of mature forest habitat within the entire study area and the buffer zones. To determine if goshawks used near-riparian areas preferentially over non-riparian habitat, we proposed to use the log-likelihood ratio (Goodness of Fit Test) based on existing proportions of suitable nesting habitat (i.e. mature forest habitat) found within each area respectively.

NEST SITE ANALYSIS

Vegetation analysis at nest sites followed the protocol developed for measuring other goshawk nests on the Forest (Patla, 1991). Within a 20 m radius circular sample plot (.126 ha) centered at the nest tree, we counted all trees greater than 3.8 cm and measured dbh (diameter at 1.4 m height) using a standard dbh measuring tape. Understory vegetation height was measured along two 20 m transects placed randomly within the circular plot. We calculated nest tree canopy cover using a spherical densiometer, taking readings in the four cardinal directions below the nest tree. For nest site canopy cover, we averaged readings taken at each cardinal point on the perimeter of the sample plot. Tree height, nest height, and slope were measured with a clinometer.

To determine potential bias in our historic nest site database, we compared nest site habitat variables of nests found during this survey with those from other sites previously identified in the Centennial Mountains and elsewhere on the Forest. Nest site density was calculated as the number of active nests found per total area surveyed.

RESULTS

SURVEY RESULTS

From mid-June to mid-August within the designated study area, we surveyed 40.5 km^2 of relatively contiguous forest habitat using broadcast vocalizations along predetermined transect lines (575 calling stations). We surveyed an additional 20 km^2 of fragmented habitat (both naturally fragmented and timber harvest areas) using broadcast calls along transects planned on-site. Approximately 24 km^2 within the study area was determined to be unsuitable for goshawk broadcast surveys due to insufficient overstory vegetation (see GIS Landscape Analysis Results).

Our survey of remote, untrailed mountain terrain in 1993 was hindered somewhat by above average precipitation levels, frequent and persistent rain storms, and below average temperatures. Compared to the 30-year mean, monthly temperatures during the goshawk nesting season, April through August 1993, averaged 2.0

degrees C below normal; precipitation averaged 2.1 cm above normal (Table 1). Survey days frequently had to be shortened or canceled due to inclement weather. All suitable habitat, however, within the study area was covered.

Two active goshawk nests were located during the survey effort. Measured by GPS positions, these sites were located 7.5 km (4.7 mi) apart. Observers working separately detected goshawk vocalizations at both sites on the same day during the nesting period, June 26. Nest #1 was located almost directly on a transect line; a pair of adult goshawks were heard vocalizing 150 m from a calling station by the observer before she began playing the broadcast call. Within a few minutes, the observer found an adult female goshawk perched near an active nest tree in the same stand from where the vocalizations were first heard. We suspect that an adult male goshawk sighted the day before on another transect line located one km to the southwest was from this territory (Table 3).

At the other site (Nest #2), a female goshawk responded to the alarm call tape with by vocalizing (alarm calls) and flying towards the observer. After a few minutes, the female left and could not be relocated. An active nest site was located a few days later after a three hour search by three observers; we found the nest tree in an adjacent drainage 350 m from where the adult female first responded to the taped call. During this

second nest search, we also discovered an active Great Gray Owl (Strix nebulosa) nest site located in an alternate goshawk stick nest. Two recently fledged Great Gray Owls (GGOW) and an adult were found roosting within 75 m of the nest. Distance between the active goshawk nest and the active owl nest was 476 m.

We searched for alternate nests within a .6 km radius of the two active goshawk nest sites. Four alternate nest trees were found within 400 m of Nest #1. The only alternate nest found near Nest #2 was the one used by GGOW. All seven nest trees were located within 250 m of a permanent water source which placed them within our defined "near-riparian" zone (Table 3). The three water sources located closest to goshawk nests were all first order streams. Riparian habitats located closest to goshawk nests were characterized by a variety of forbs and grasses (Table 4). These habitats correspond to the "mesic forb meadow" community type described by Youngblood, et al. (1985) and to Region II mesic meadow communities as defined by Douglas (1992).

Three goshawks fledged from active nesting territories within the study area in 1993: two fledged on or near July 13 (Nest #2), and one fledged (Nest #1) almost two weeks later on July 28/29 (Table 2). The fledglings from the first site remained in the nest stand at least until August 8. The solitary fledgling at the other site was seen only one time post-fledging.

During later visits to the nesting area, we did not see or hear the young or the adults at this site (Table 2).

Three other observations of adult goshawks did not result in location of an active nesting territory. An adult male was seen on June 17 near Castle Peak, and on two separate days (July 29 and August 12), a male was seen flying south below the Continental Divide flying along the ridge just east of Pete Creek (Table 3). A male sighted in July was carrying prey (medium sized bird). We obtained a flight bearing on this bird but it did not lead to suitable nesting habitat in the immediate vicinity. Further surveys of mature stands in the Pete Creek/Castle Peak area did not result in additional sightings or evidence of nesting activity. From the bearing obtained in July, it is possible that the male goshawk sighted was returning to Nest #2 which was located 4.9 km (3.03 mi) to the southeast.

Other bird species which responded to the broadcast goshawk vocalizations during surveys included Gray Jay (the most frequent respondent), Steller's Jay , Northern Flicker (Colaptes aurates), Clark's Nutcracker (Nucifraga columbiana), Red-breasted Nuthatch (Sitta canadensis), Common Raven (Corvus corax), and Red-tailed Hawk (Buteo jamaicensis).

Nine species of raptors besides Northern Goshawk and two species of owls were sighted within the survey area (Table 5,

Table 6). The Red-tailed Hawk was the most frequent raptor sighted. It was seen throughout the survey period and study area. On one occasion, near goshawk nest Site #1, we observed an adult Red-tailed Hawk chasing a goshawk above the canopy.

Great Horned Owls (Bubo virginianus) were sighted on four separate occasions (Table 6). They were always seen near the edge of the forest or in very open stands. In addition to the active Great Gray Owl nest found near the active goshawk nest (#1), an adult Great Gray Owl was observed twice during the month of July roosting in mature Douglas fir trees in the vicinity of Nest #2. We searched for fledged owls and an owl nests in this area but did not find any indication of an active nest site.

GIS LANDSCAPE ANALYSIS RESULTS

Using ARC/INFO GIS software, we calculated that 21.52 km^2 or 25.4% of the study area (84.70 km^2 total) fell within 250 m of a permanent water source (near-riparian area) (Fig 3). Distribution of vegetation cover types within the near-riparian zone was similar to that found within the study area over all (Table 7). Mature timber covered over 70% of the entire area; 75.8% of the near-riparian was also classified as mature timber habitat. Douglas fir was the most abundant overstory cover type within this habitat classification, accounting for 69% of existing mature forest habitat.

Assuming that all unharvested mature forest habitat within the study area is potential goshawk nesting habitat, goshawk nesting density in 1993 was 1 pair per 30.2 km^2 (11.7 mi^2). Since nests were found only in Douglas fir stands, density calculated for that cover type alone equals 1 pair per 20.6 km^2 (8.0 mi^2).

Considering overall mature forest habitat, 27.0% (16.3/60.4 km^2) was located within the near-riparian zone. The percentage of total mature Douglas fir habitat contained within the near-riparian zone was similar, 27.2% (11.2/41.2 km^2).

Given the low number of nesting areas found (n=2), we could not perform any rigorous statistical testing of goshawk habitat selection for near-riparian areas. A trend for placement of nest sites within the near-riparian zone is suggested, however, as all seven active and alternate nests occurred within this defined area even though it comprised only 27% of potential goshawk nesting habitat within the study area.

NEST SITE HABITAT ANALYSIS

All seven goshawk nests within the study area were found in mature Douglas fir trees between 2116 m and 2250 m elevation (Table 8). Mean dbh (trunk diameter at 1.4 m above ground) of nest trees was 59.1 cm (4.7 cm SD); tree height averaged 29.7 m

(3.4 m SD), and mean tree age was 153 years (26.8 SD). Goshawks placed nests below the green canopy at an average height of 15.6 m (1.8 m SD). Nest height to tree height ratio was .52.

Nest trees were found on 10-47% slopes (average 25%) with north to northeast aspects (0 to 50 degrees). Canopy cover averaged 82% both under the nest tree and at the edge of the habitat plot (20.1 m radius). Comparing characteristics of these seven nest trees to 37 other Douglas fir nest trees found active on the Targhee National Forest between 1989 and 1993, we found no significant differences (Table 8).

We measured nest site vegetation plots (20.1 m radius circle; .062 ha) at six of the seven nest tree locations within the study area. We did not take plot data at one alternate nest tree in nest area #1 as it was located only 16 m from another alternate nest tree; we measured the tree which appeared to contain the most recent stick nest. Douglas fir was the only mature conifer (dbh > 17.8 cm) in four of the six plots. Two of the plots had small percentages of mature subalpine fir and lodgepole pine (8% and 16%).

We found an average of 426 live mature trees/ha (sawtimber > 17.8 cm) at goshawk nest sites (range 236-598 trees/ha; 122 SD). Mean dbh of mature conifers was 36.6 cm (3.5 cm SD). Snags (dbh greater than 1.5 cm) averaged 18.2 cm (4.7 cm SD) dbh; we

measured an average of 295 snags/ha (range 32-661; 271.1 SD). Compared to plots measured at 32 other Douglas fir nest trees on the Forest, we found no significant differences in density or size of live trees or snags (Table 9).

To analyze the distribution of tree sizes found within plots, we calculated how many trees/ha occurred within 7.62 cm (3") size classes for all trees equal or greater than 7.62 cm dbh (Fig. 4). Fifty-four percent of all live trees within plots were less than 30.5 cm (12" dbh) indicating the multistory character of nesting stands. Compared to 32 plots measured at other Douglas fir trees on the Forest, the only significant difference was found in size class 15.2-22.8 cm. The survey area nest sites had significantly fewer trees in this size class ($D=0.0771$, $p < 0.01$; Kolmogorov-Smirnov two-sample test for larger samples) (Sokol and Rohlf, 1969).

Understory vegetation at study area nest sites consisted mainly of short grasses and forbs. Average height of ground vegetation measured 17.5 cm (8.1 cm sd). Mean ground cover height for other nests on the forest was 19.5 cm (10.2 sd) which was not significantly different from the study area nests (T test: $t= 0.459932$, $p=0.648$. alpha= 0.05).

DISCUSSION

Traditional goshawk nesting territories contain a number of alternate nests and can be reoccupied by goshawks for many years (Woodbridge, in press). Territories are often spaced regularly across the landscape where suitable habitat exists but at relatively low densities. Reynolds (1983) estimated density of goshawk nests in eastern Oregon using mean nearest neighbor distance. Mean internest distance was 5.6 km (range 2.4-8.4 km). Mean distance between 97 nests on the Wallowa-Whitman National Forest in Oregon was reported to be 5.9 km (Anderson and Schommer, 1992). Internest distance of active goshawk nests found in this study (7.5 km) fall within the range reported by Reynolds suggesting that our survey methods were successful.

Occupancy and productivity of previously identified goshawk nests on the Targhee National Forest in 1993 were greatly reduced compared to 1992 data from the same area. In 1992, we found 21 active nests which produced an average of 2.26 young/successful nest. In 1993, we could find only 12 active nests (including nests found in this study) which produced an average of 1.54 young/successful nest (Patla, unpublished data). Analyzing the effects of mean monthly precipitation (March-July), mean monthly temperature (March-July) and average snow depth (March-May) on nest productivity, we found a significant correlation between productivity and weather factors (Table).

Productivity was correlated negatively with May precipitation (p=.018) and positively with April temperature (p=.002) (Multiple Regression, Systat). Considering the five year period from 1989-1993, the lowest average March temperature occurred in 1993. May precipitation in 1993 was exceeded in one year, 1991. Productivity in both 1991 and 1993 was below 2 young/successful nest.

Considering the wet, cold spring and summer weather in 1993, it is very possible that additional goshawk nesting territories may exist within the study area but were unoccupied in the survey year. Nesting territories that are successful in a poor productivity year such as 1993 may be high quality sites with a more stable supply of food even in poor years (Newton, 1979, 1986). It is difficult to separate out the effects of territory quality from variation in individual pair productivity, however.

All nest trees both active and inactive within the study area were located a mean distance of 152 m from a permanent water source (range 15-234 m). Water sources (n=3) at all sites were first order streams with low but persistent flow even into fall. Stream width did not exceed 30.5 cm. Gradients were low and moving water did not create noticeable noise. Two of the streams had mature conifers within 2-10 m along the edge. The other stream was surrounded by a long narrow meadow opening measuring approximately 100 m wide by 450 m long. The nest tree in this

situation was close to the forest edge (60 m) but could not be seen from the meadow. The riparian habitat at all water sources was classified as mesic forb meadow community type (Youngblood, et al., 1985)

At thirteen Douglas fir nest sites within the Centennial Mountains which had been active at least once between 1989 and 1993, we sampled random habitat plots (20.2 m circle) within the estimated home ranges. The random sites were located a greater mean distance from water sources than the active sites (293 m compared to 208 m) but this was not a statistically significant distance (T test). If ramdon samples had been taken across the entire landscape, however, rather than just within a 1.7 km distance of active nests, the difference may have been more pronounced.

Fifteen active nest sites within the Centennial Mountains (not including the nests from this study) were located a mean distance of 238 m (180 m SD) from water sources. Eight were near first order streams (53%), four near streams or ponds (27%), two near second order streams (13%), and 1 near a third order stream (6%). Except in one case, those nests closest to second and third order streams were located a greater distance from water than nests near first order streams (470 m compared to 143 m).

Shuster (1976) suggested that in Colorado goshawks seem to

avoid placing nests near large, noisy streams. Our data from the Targhee support this hypothesis as well. Observing nesting female goshawks from blinds during the nestling period (1992-1993), it was very obvious that the ability to hear played an important role both in nest defense and interactions with the adult male. The female would become very alert upon hearing noises whether from prey, potential predators, or calls from her mate. She would often leave the nest to investigate such sounds (pers. obs). Noisy moving water would greatly hinder her ability to detect activity around the nest site.

The presence of a permanent, quiet, water source close to active goshawk nest sites could prove advantageous for a number of reasons. Increased prey availability, water for drinking and bathing, and the opportunity for frequent bathing to control nest humidity in dry climates or at open canopy nest sites have all been suggested as reasons why goshawk nests are often located near water (Palmer, 1988; Crocker-Bedford and Chaney, 1988; Marshall, 1992).

A review of goshawk nest site studies in the western United States indicates that a majority of the nests measured fell within the 250 m buffer zone defined in this study as the near-riparian area (Table). One potential problem obvious from compiling these data was that nests located at a great distance from water tend not to be included in reported distances or even

measured. There appears to be general agreement, however, that even though some goshawk nests are found at great distances from water, the presence of water is desired characteristic (Marshall, 1992).

Our survey in the Centennial Mountains of eastern Idaho, while not able to show preferential selection for locations near water, does support the idea that availability of water may be an important factor in goshawk nest site selection. It also suggests that first order streams with grass forb meadow riparian habitat may be a landscape feature to consider when planning for goshawk nesting areas in northern and middle Rocky Mountain habitats.

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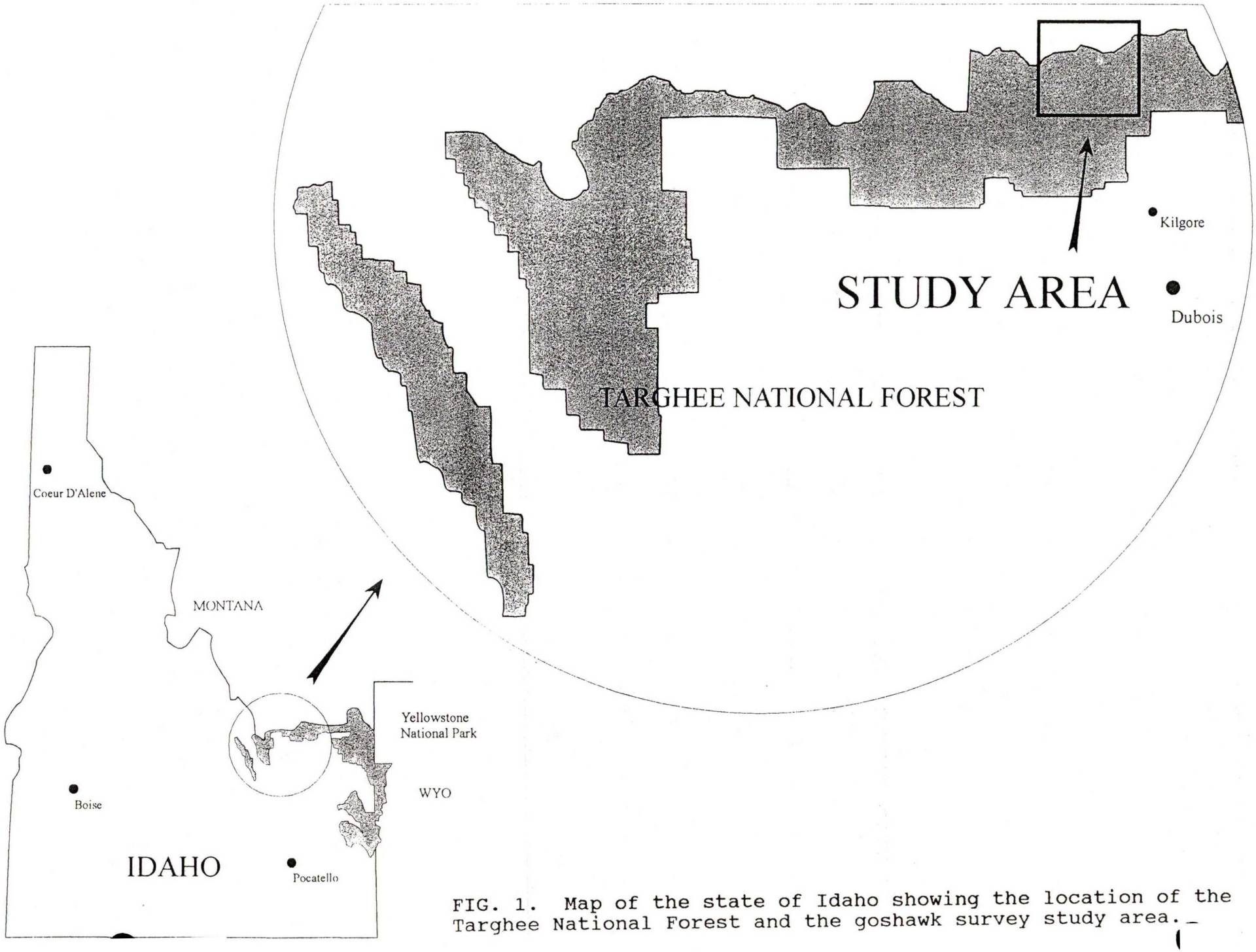

FIG. 1. Map of the state of Idaho showing the location of the Targhee National Forest and the goshawk survey study area.

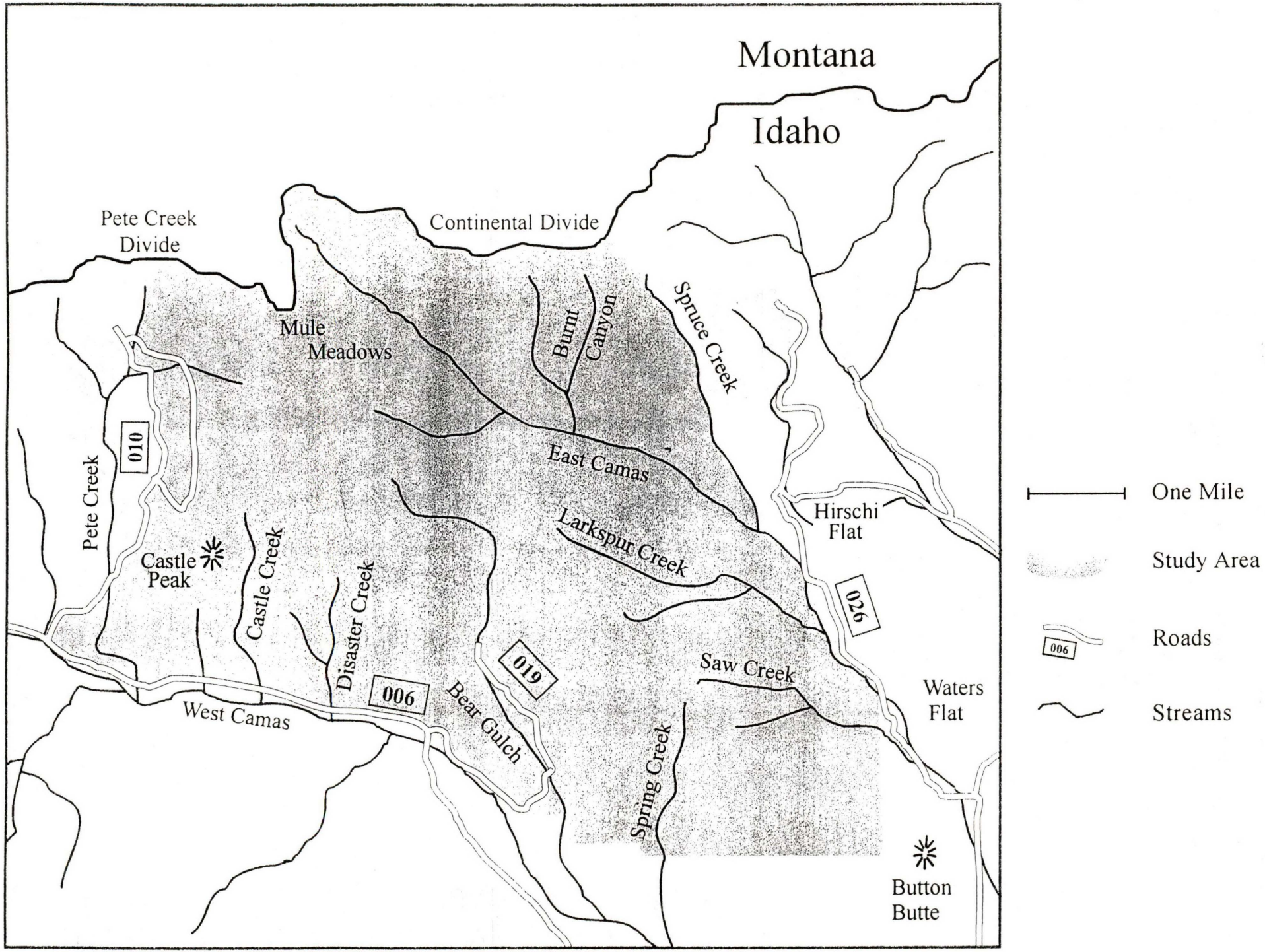

FIG. 2. Map of goshawk survey area (shaded area) showing major roads and streams, Centennial Mts., Targhee National

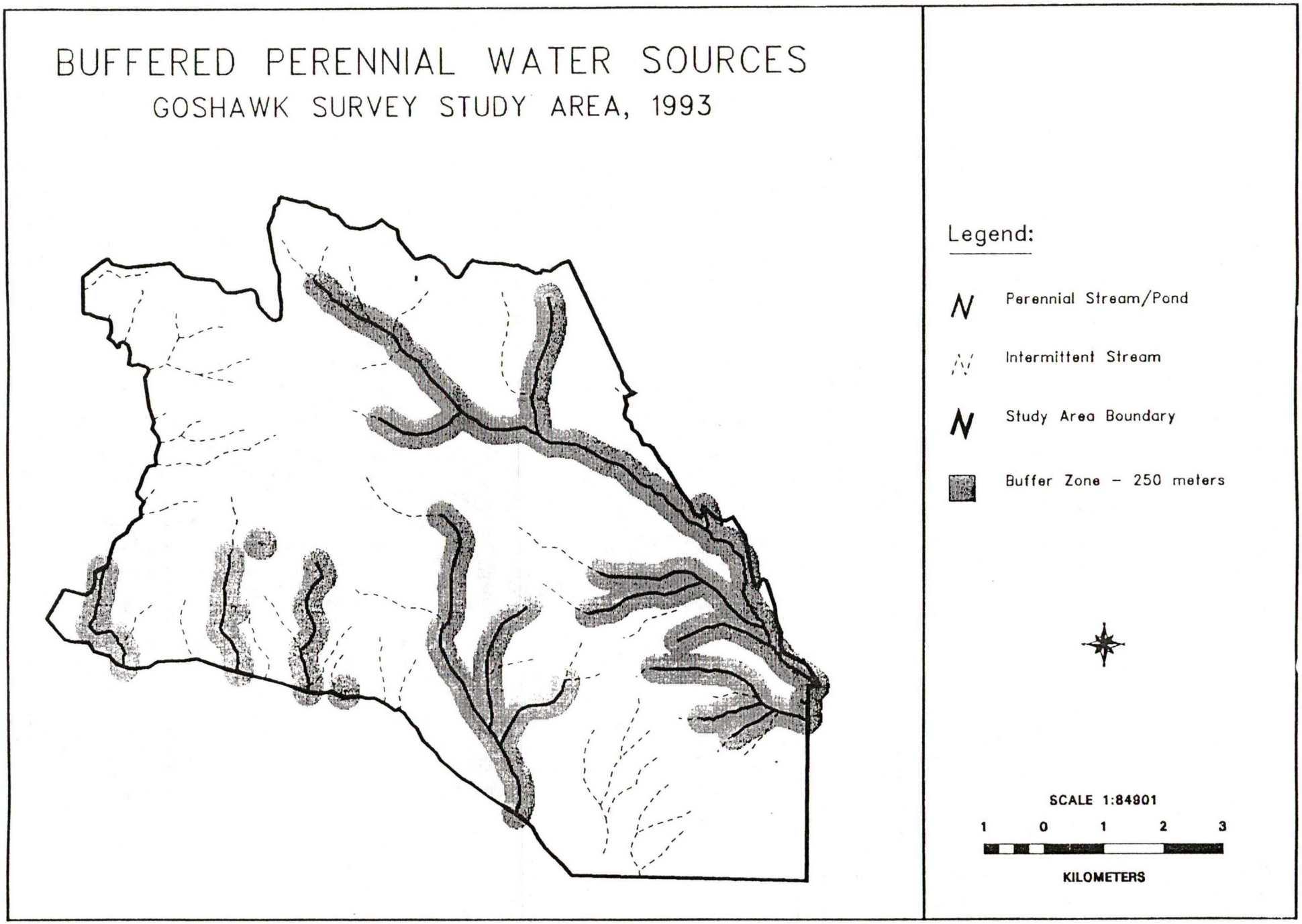

FIG. 3. GIS coverage of goshawk survey area showing perennial drainages with 250 m buffer zones used to calculate near-riparian area.

TABLE 1. Monthly average temperature and precipitation data for 1993 compared to thirty year mean for Dubois Experimental Station (Station #2707: Lat. 4412 Long. 11212 Elev. 1662 m).

MONTH	AVG TEMP (C)	DEPARTURE FROM 30 YR MEAN	TOTAL PRECIPITATION (cm)	DEPARTURE FROM 30 YR MEAN
JAN	-7.8	-0.3	4.11	2.29
FEB	-6.3	-1.5	2.18	0.51
MAR	-0.6	0.3	2.01	-0.10
APR	4.5	-0.8	4.78	2.18
MAY	12.2	1.4	9.09	4.83
JUNE	13.1	-2.5	4.75	0.15
JULY	14.5	-5.3	5.23	2.41
AUG	16.6	-2.8	3.48	0.76
SEPT	13.7	-0.2	0.20	-2.51
MEAN		-1.4		1.17
STD		2.1		2.06

TABLE 2. Date and location of Northern Goshawk sightings within survey area (1993), Centennial Mts., Targhee National Forest, Idaho. Location of active nest areas have not been included in the list below for protection of nesting territories. NOGO = Northern Goshawk

DATE	SIGHTING	TRS	OBSERVATIONS
NEST AREA #1			
6/25	adult male		Male flew over
6/26	pair		Pair vocalizing by active nest along transect
7/01	NOGO nest		Nest check; female called 70 m from nest
7/13	nest check		Female called when oberservers 30 m from nest
			One downy young on nest; pin feathers pushing
7/21	nest check		Female dove at obs., one young with downy underside on nest
7/26	nest check		Young on edge of nest; almost completely feathered
7/27	NOGO feathers		NOGO feathers & grouse remains; head Spring Cr.
7/30	nest check		Young fledged; perched 50 m from nest at same height
8/06	fledge check		No goshawks seen or heard
8/11	fledge check		Played wail call; no goshawks seen/heard
8/13	fledge check		Checked nest area again; no goshawks present
NEST AREA #2			
6/26	adult female		East fork Disaster Creek; responded to tape
7/01	NOGO nest		Found nest 350 m from where female called 6/26
7/13	nest check		Female dove at observers 30 m from nest
			One young on ground; other branching
8/06	fledge check		Two fledges 300 m from nest; calling loudly
OTHER SIGHTINGS			
6/17	adult	T14N R38E S36	Castle Peak area: flew in, did not vocalize
7/29	adult male	T14N R38E S19	Carrying prey over Pete Creek Divide
8/12	adult	T14N R37E S19	Flew over same location Pete Creek Dvide

TABLE 3. Distances (m) between active and alternate goshawk nests, and between nest sites and water sources found within the survey study area (1993), Centennial Mts., Targhee N.F., eastern Idaho. Distance between the two active nests found measured 7.5 km.

NEST AREA	NEST	DISTANCE to ACTIVE NEST (m)	DISTANCE FROM WATER SOURCE (m)	TYPE WATER SOURCE
#1	active		234	first order stream
	alternate #2a	118	196	first order stream
	alternate #2b	114	196	first order stream
	alternate #3	219	15	first order stream
	alternate #4	462	224	first order stream
#2	active		81	first order stream
	alternate #2	476	118	first order stream
	MEAN		152	
	SD		82.4	

TABLE 5. Date and location of raptor sightings within and adjacent to goshawk survey area (1993), Centennial Mts., Targhee National Forest, eastern Idaho.

DATE	SPECIES CODE	TRS	COMMENTS

TO BE SUBMITTED IN FINAL REPORT

TABLE 6. Date and location of owl species sighted within and adjacent to goshawk survey area (1993), Centennial Mts., Targhee National Forest, eastern Idaho.

DATE	SPECIES CODE	TRS	COMMENTS

TO BE SUBMITTED IN FINAL REPORT

TABLE 7. Landscape analysis of survey study area and perennial stream buffer areas showing cover type, code, area, and percent of total area. Area data calculated from ARC/INFO GIS coverages provided by Targhee National Forest.

		STUDY AREA		STREAM BUFFERS	
COVER TYPE*	VEG CODE	AREA (km ^ 2)	PERCENT	AREA (km ^ 2)	PERCENT
Mature Timber	9	60.40	71.3	16.30	75.8
Mature Harvested	1DF	6.76	8.0	1.49	6.9
Pole Timber	8	1.09	1.3	0.29	1.3
Seedling Timber	6	2.70	3.2	0.87	4.0
Nonstocked	5	1.89	2.2	0.13	0.6
Tall sage/grass	TSG	7.00	8.3	1.30	6.0
Grass/forb	GRF	2.51	3.0	0.35	1.6
Grass/brush	GRB	0.59	0.7	0.15	0.7
Grass	GR	0.69	0.8	0.37	1.7
Mountain Brush	MB	0.06	0.1	0.06	0.3
Rock	R	0.31	0.4	0.06	0.3
Miscellaneous		0.70	0.8	0.15	0.7
TOTAL		84.70	100.0	21.52	100.0

*Vegetation Timber Classifications:

Mature	Douglas fir (DF) >20.3 cm dbh, other conifers >17.8 cm dbh
Pole	DF 7.8-20.3 cm dbh, other conifers 7.8-17.8 cm dbh
Seedling	15.2 cm height to 2.5 cm dbh
Nonstocked	seedlings less than 15.2 cm height